Diaphragm valve and open/close element for said valve

This invention addresses a diaphragm valve, which comprises a valve body, consisting of an inlet sleeve and an outlet sleeve, which have a curved shape and equal circular sections, and converge at least partly to a fluid flow chamber, which contains the valve seat, substantially consisting of the flattened and slightly concave surface of the line of intersection of the two sleeves on the opposed sides thereof, which chamber is divided into two parts with respect to a plane parallel to the plane tangent to the lower apex of the valve seat surface, one part whereof is integrated in the valve body, and is peripherally delimited by a clamping flange, and the other part consists of a bonnet to be sealably secured onto said valve body, which bonnet has a coincident peripheral clamping flange, an elastic diaphragm being provided, made of rubber or the like, which has a peripheral sealing flange to be clamped between the peripheral flanges of said two parts of the chamber, said flange being connected to a central dome-shaped convex part whose convexity is oriented, in an unstressed position, toward the valve seat, and means being provided on the concave side of the diaphragm, facing toward the bonnet, to compress the diaphragm against the valve seat surface in such a manner that, when the diaphragm is compressed against said surface, any fluid flow from the inlet sleeve to the outlet sleeve is prevented whereas, when the diaphragm is

lifted and deformed toward the bonnet, free fluid flow is allowed.

In such prior art valves, typically in the valve body, the sum of inlet and outlet sections are inscribable in a substantially circular shape or in any such shape that is inscribable in a square, as it is generated by the confluence of two circular and substantially constant sleeves. Therefore, the diaphragms are circular in the concave part and have square flanges. For this reason, these valves have large sizes and considerable space requirements, particularly in the axial direction of flow, and their fabrication requires the use of a considerable amount of metal, resulting in very heavy weight and considerable costs, particularly as flow rates and inlet and outlet sleeve diameters, i.e. overall valve sizes, increase. Furthermore, particularly in hydraulically operated valves, the pressure exerted by the fluid that is piped in the pressure chamber between the bonnet part and the valve closing dome of the diaphragm may cause the diaphragm to bow out, particularly into the outlet sleeve port, wherein no counterbalancing pressure is provided, and this causes the so-called balloon effect. This drawback is also dependent on the considerable length of the radius of the circular diaphragm, when seen in the axial direction of the flow, and more particularly of the long axial diameter of the outlet sleeve port opening into the flow chamber and is particularly serious in large-size valves, operating at very high flow rates

and having wide diaphragm surfaces. The drawback may cause the unsupported diaphragm to be damaged, thereby leading to seal defects and/or opening/closing problems, due to the fact that the diaphragm is only partly resilient or is not resilient at all. In order to obviate this drawback, a rib may be provided in an intermediate position of the outlet sleeve port opening into the flow chamber, which rib is oriented in the flow direction and is substantially perpendicular to the plane tangent to the lower apex of the valve seat. This rib has, at its edge facing toward the dome of the diaphragm, a flattened surface and appropriately curved to prevent the dome from bowing out when the latter is compressed against the valve seat. Nevertheless, this rib causes an increase of the construction complexity of the valve, as well as its weight and cost, and does not solve the problem of the large size, in the flow direction, of prior art valves and, from the functional point of view, leads to a possible build up of filamentary matters.

Therefore, this invention has the object of obviating the above drawbacks, thereby providing, by using simple and inexpensive means, a valve as described hereinbefore, whose diaphragm is not subjected to any abnormal deformation and consequent early wear and/or malfunctioning during use, and has an axial size, a weight and fabrication costs that are lower than in prior art valves.

The invention achieves the above purposes by providing a valve ad described hereinbefore, in which

the cross section of outlet and inlet sleeves, at the ends opening into the flow chamber, and at the valve seat, is flattened in the direction of flow, i.e. along the axis that joins the centers of the two inlet and outlet ends of the sleeves, opening into the flow chamber, and is elongated in a direction transverse to the direction of flow, particularly having a substantially elliptic shape, or anyway inscribable in a substantially rectangular peripheral clamping flange, and with the longer side disposed in a direction transverse to the direction of flow. Hence, the peripheral flange of the diaphragm may have a corresponding rectangular shape, inscribing the central convex portion of the diaphragm, which consists of an element having the shape of a sector of an ellipsoid or similar, whose section plane is disposed in such a manner as to correspond with the flow chamber port.

It shall be noted that the inventive concept defined as "flattened in the flow direction" includes all diaphragm valves and all diaphragm-like open/close elements in which the extension in the direction of flow, of the flow chamber, or the flow chamber closing and diaphragm clamping flange, is shorter than the extension in the direction transverse to the flow direction.

According to a preferred embodiment of the invention, which will be described in greater detail in the explanation of the drawings, from the respective free ends to the ends that open into the flow chamber, the two sleeves may have a cross section that

CLAIMS

1. A diaphragm valve (5), which comprises a valve body (1), consisting of an inlet sleeve (3) and an outlet sleeve (4), which have a curved shape and equal circular sections, and converge one into the other until they open into a fluid flow chamber, which contains the valve seat (106), substantially consisting of the flattened and slightly concave surface of the line (6) of intersection of the two sleeves (3, 4) on the opposed sides thereof, which chamber is divided into two parts with respect to a plane parallel to the plane tangent to the lower apex of the surface of the valve seat (106), one part whereof is integrated in the valve body (1), and is peripherally delimited by a clamping flange (101), and the other part consists of a bonnet (2) to be sealably secured onto said valve body (1), which bonnet has a coincident peripheral clamping flange (102), an open/close element consisting of an elastic diaphragm (5) being provided, made of rubber or the like, which has a peripheral sealing flange (105) to be clamped between the peripheral flanges (101, 102) of said two parts of the chamber, said flange (105) being connected to a central dome-shaped convex part (305) whose convexity is oriented, in an unstressed position, toward the valve seat (106), and means being provided, on the concave side of the diaphragm (5), facing toward the bonnet, to compress the diaphragm against the surface of the valve seat (106) in such a manner that, when the diaphragm (5) is compressed

against said surface (106), any fluid flow from the inlet sleeve (3) to the outlet sleeve (4) is prevented whereas, when the diaphragm (5) is lifted and deformed toward the bonnet (2), free fluid flow is allowed, characterized in that the cross sections of the inlet sleeve (3) and the outlet sleeve (4), at the ends opening into the flow chamber, and at the valve seat (106), are flattened in the direction of flow, i.e. along the axis that joins the centers of the two inlet and outlet ends of the sleeves, opening into the flow chamber, and are elongated in a direction transverse to the direction of flow, particularly having a substantially elliptic shape, or anyway inscribable in a substantially rectangular peripheral clamping flange (101), and with the longer side disposed in a direction transverse to the direction of flow, the peripheral flange (105) of the diaphragm (5) having a corresponding rectangular shape, inscribing the central convex portion (305) of the diaphragm (5), which consists of an element having the shape of a sector of an ellipsoid or similar, whose section plane is disposed in such a manner as to correspond with the flow chamber port.

2. A valve as claimed in claim 1, characterized in that, from the respective free ends to the ends that open into the flow chamber, the sleeves (3, 4) have a cross section that progressively widens in a direction transverse and perpendicular to the flow direction and parallel to the separation plane between the two chamber parts (1, 2), and progressively narrows in a